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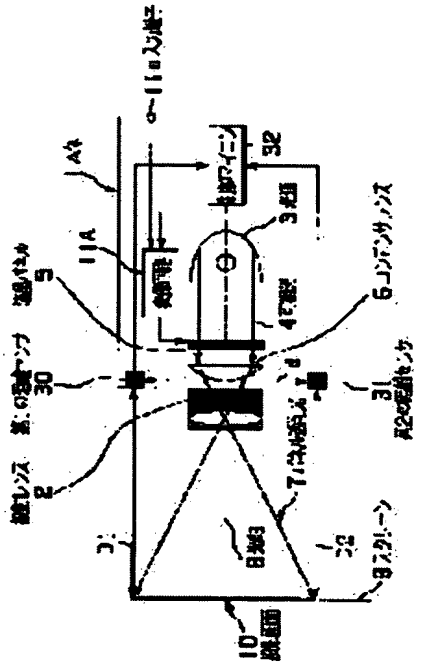
(54) TRAPEZOIDAL DISTORTION CORRECTION DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To automatically and surely correct a trapezoidal distortion generated on a projection picture plane without requiring a troublesome correction operation by a user.

SOLUTION: A first and a second distance sensors 30, 31 installed plurally on different positions on the front of a liquid crystal projector body 1 detect the distances between the body 1 and a screen 9, respectively. A control microcomputer 32 calculates the angle of inclination of the body 1 relative to the screen 9 based on the result of detection, and controls and image processing circuit 11A capable of thinning adjustment of the pixel data of each line based on the result of calculation, so that the projection image light of a liquid crystal panel 5 will form a trapezoidal distortion shape reverse to the trapezoidal distortion shape of a projection picture plane caused by the angle of inclination of the body 1. Hereby, the trapezoidal distortion generated on the projection picture plane can be automatically corrected without requiring a troublesome operation by a user.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] It is the processing circuit which performs processing for making the image based on said input video signal form on said liquid crystal panel side. By having the memory which memorizes the pixel data corresponding to an input video signal, and changing the writing for every Rhine of the pixel data of this memory, and the timing of read-out Based on the detection result from the image processing circuit which can infanticide adjust pixel data and said distance detection means for every Rhine, the tilt angle of said body of a liquid crystal display over said screen is computed. The keystone distortion compensator characterized by providing the amendment control means which controls said image processing circuit automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result.
[Claim 2] In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The condensing lens equipped with the driving means to which it is a lens for condensing the projection image light from said liquid crystal panel, and irradiating to a screen through a projector lens, and the tilt angle of this lens itself is changed free, Said driving means of said condensing lens A controllable include-angle adjustment means, Based on the detection result from said distance detection means, the tilt angle of said body of a liquid crystal display over said screen is computed. The keystone distortion compensator characterized by providing the amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result.
[Claim 3] In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The liquid crystal panel equipped with the driving means to which the tilt angle of said liquid crystal panel itself is changed free, Based on the detection result from a controllable include-angle adjustment means and said distance detection means, the tilt angle of said body [as opposed to said screen

for said driving means of said liquid crystal panel] of a liquid crystal display is computed. The keystone distortion compensator characterized by providing the amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result.

[Claim 4] Said amendment control means is the keystone distortion compensator of any one publication of claim 1 which controls said image processing circuit means or said include-angle adjustment means so that the projection image light which has a keystone distortion configuration contrary to the keystone distortion configuration of the projection screen resulting from the tilt angle of said body of a liquid crystal display is obtained based on said calculation result thru/or claim 3.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the keystone distortion compensator which amends the keystone distortion which originates in the installation condition of a front projection mold liquid crystal projector, and is produced on the projection image, and relates to the keystone distortion compensator which does not need the troublesome manual operation by the ** user, but can amend a keystone distortion automatically and the optimal.
[0002]
[Description of the Prior Art] In recent years, development of the liquid crystal projector using a liquid crystal panel is briskly performed with the demand of a small and lightweight display unit by the big screen. Since big-screen-izing is easy, the liquid crystal projector is expected also as an object for high definition televisions.
[0003] especially it can be used, the liquid crystal projector of a front projection mold being able to be small and lightweight, and installing it simply, and since it is not so expensive in cost, a user enjoys popularity in recent years — it has both spread broadly and future need is also fully expected.
[0004] Therefore, in order to satisfy a demand of such a user, not to mention acquiring the projection image which was excellent in the liquid crystal projector of a front projection mold, without dropping the grace of the projection image, even when distortion etc. occurs on the projection image, it is temporarily required for it to have immediately the function which can be amended, and it is desirable for the amendment engine performance to be highly precise.
[0005] An example of the liquid crystal projector of the conventional common front projection mold equipped with such an amendment function is shown in drawing 8 .
[0006] As shown in drawing 8 , it has input terminal 1a for inputting the video signal of the image source to display into a liquid crystal projector, and the input video signal supplied through this input terminal 1a is supplied to the image circuit 11 as a main circuit established in the body 1 interior.
[0007] The image circuit 11 is made to amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, in order to usually reproduce the image based on an input video signal correctly, or a processing circuit required to amend the liquid crystal drive circuit which has functions, such as performing the alternating current drive for the reinforcement of liquid crystal, and a keystone distortion etc. becomes main, and it is constituted. That is, by performing signal processing required in order to display the image based on an input video signal on the screen of the liquid crystal panel 5 used for this liquid crystal projector to an input video signal, the image circuit 11 acquires the panel driving signal according to an input video signal, and gives it to a liquid crystal panel 5. Thereby, the image screen based on an input video signal is displayed on the screen of a liquid crystal panel 5.
[0008] On the other hand, the light 4 irradiated from the light source 3 using the reflector etc. penetrates the screen of a liquid crystal panel 5, and the transmitted light 7 of the transmitted liquid crystal panel 5 is narrowed down with a condensing lens 6, and it expands and displays it on a screen 9 by carrying out expansion projection with a projector lens 2. By this, on a screen

9, the image screen displayed on said liquid crystal panel will be formed as a projection screen 10.

[0009] By the way, generally, since a viewer views and listens to the projection screen behind behind a body 1 in many cases, such a front projection mold liquid crystal projector may be installed so that a body 1 may not interrupt a viewer's field of view. That is, a body 1 will be installed at the include angle projected so that a projection screen may be located in the body 1 upper part. However, in such a case, the projection screen 10 with distortion generally called keystone distortion (called keystone distortion) will be formed by the gap of whenever [angle-of-projection / which originated in the installation condition of the liquid crystal projector body 1 as shown in drawing 9].

[0010] As a means to amend such a keystone distortion, generally there are two approaches, it is the amendment approach in which one carries out keystone distortion amendment electrically, and another is the amendment approach which carries out keystone distortion amendment optically.

[0011] The approach of carrying out keystone distortion amendment electrically is the approach of amending the keystone distortion of a projection screen by displaying the image screen which has a keystone distortion contrary to a projection image in the screen of a liquid crystal panel 5 by the image circuit 11, and carrying out expansion projection of this.

[0012] Another approach of carrying out keystone distortion amendment optically is the approach of amending the keystone distortion of a projection screen by adjusting the inclination of a condensing lens 6 within the liquid crystal projector body 1.

[0013] Or a keystone distortion can be amended by adopting the structure where a condensing lens 6 is not leaned but liquid crystal panel 5 the very thing is leaned.

[0014] However, by the conventional electric and optical keystone distortion amendment approach mentioned above, there was a trouble that the contents of actuation were complicated and it could not carry out easily from it being what all performs the amendment by actuation of a user since delicate level adjustment etc. is required in order to carry out keystone distortion amendment certainly.

[0015]

[Problem(s) to be Solved by the Invention] Although it had amended by the conventional keystone distortion amendment approach like the above so that the keystone distortion which the transmitted light of the input video signal itself or a liquid crystal panel was made to generate a keystone distortion contrary to a projection screen electrically or optically, and was produced on the projection screen might be mitigated By these approaches, there was a trouble that the contents of actuation were complicated and it could not carry out easily from it being what all performs the amendment by actuation of a user since delicate level adjustment etc. is required in order to carry out keystone distortion amendment certainly.

[0016] Then, this invention was made in view of the above-mentioned problem, and does not need the complicated remedial operation by the user, but aims at offer of the keystone distortion compensator which can amend the keystone distortion produced on the projection screen automatically and certainly.

[0017]

[Means for Solving the Problem] The keystone distortion compensator by invention according to claim 1 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] It is the processing circuit which performs processing for making the image based on said input video signal form on said liquid crystal panel side. By having the memory which memorizes the pixel data corresponding to an input video signal, and changing the writing for every Rhine of the pixel data of this memory, and the timing of read-out Based on the detection result from the image processing circuit which can infanticide adjust pixel data and said distance detection means for

every Rhine, the tilt angle of said body of a liquid crystal display over said screen is computed. The amendment control means which controls said image processing circuit automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.
[0018] According to this invention, the distance of this body of a liquid crystal display and said screen is detected by the distance detection means formed in the location where said front faces of the body of a liquid crystal display differ, respectively. [two or more] Infanticide adjustment of the pixel data for every Rhine is possible for said image processing circuit by being the processing circuit which performs processing for making the image based on said input video signal form on said liquid crystal panel side, having the memory which memorizes the pixel data corresponding to an input video signal, and changing the writing for every Rhine of the pixel data of this memory, and the timing of read-out. At the time of keystone distortion generating, an amendment control means computes the tilt angle of said body of a liquid crystal display over said screen based on the detection result from said distance detection means, and it controls said image processing circuit automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result. Thereby, since the projection image light of a liquid crystal panel becomes what is contrary to the keystone distortion configuration of said projection screen that carries out keystone distortion ******, a keystone distortion can be mitigated as a result and it becomes possible to perform this keystone distortion amendment automatically moreover.
[0019] The keystone distortion compensator of invention according to claim 2 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The condensing lens equipped with the driving means to which it is a lens for condensing the projection image light from said liquid crystal panel, and irradiating to a screen through a projector lens, and the tilt angle of this lens itself is changed free, Said driving means of said condensing lens A controllable include-angle adjustment means, Based on the detection result from said distance detection means, the tilt angle of said body of a liquid crystal display over said screen is computed. The amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.
[0020] According to this invention, the projection image light of a liquid crystal panel which has a keystone distortion configuration contrary to the keystone distortion configuration of said projection screen by controlling said include-angle adjustment means by said amendment control means, and changing the tilt angle of a condensing lens by it is obtained. Thereby, the same effectiveness as the above-mentioned invention is acquired.
[0021] The keystone distortion compensator of invention according to claim 3 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The liquid crystal panel equipped with the driving means to which the tilt angle of said liquid crystal panel itself is changed free, Based on the detection result from a controllable include-angle adjustment means and said distance detection means, the tilt angle of said body [as opposed to said screen for said driving means of said liquid crystal panel] of a liquid crystal display is computed. The amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.

[0022] According to this invention, the projection image light of a liquid crystal panel which has a keystone distortion configuration contrary to the keystone distortion configuration of said projection screen by controlling said include-angle adjustment means by said amendment control means, and changing the tilt angle of a liquid crystal panel by it is obtained. Thereby, the same effectiveness as the above-mentioned invention is acquired.
[0023]
[Embodiment of the Invention] The gestalt of implementation of invention is explained with reference to a drawing. Drawing 1 is the block diagram in which showing the gestalt of 1 operation of the keystone distortion compensator of this invention, and showing the example of a configuration of the liquid crystal projector of the front projection mold constituted by incorporating this equipment.
[0024] In order to amend automatically the keystone distortion of the projection screen which originates in the installation condition of the liquid crystal projector of a front projection mold, and is produced with the gestalt of this operation The 1st and 2nd distance robots 30 and 31 as a distance detection means which detect distance with a screen 9 up and down the front-face side of the liquid crystal projector body 1, respectively are formed. He is trying to attain the purpose by performing processing in the image circuit used with the conventional technique based on the detection result obtained by these 1st and 2nd distance robots 30 and 31.
[0025] The front projection mold liquid crystal projector which incorporated the keystone distortion compensator of the gestalt of this operation as a concrete whole configuration has the description in the point of having prepared the 1st and 2nd distance robots 30 and 31 of the above, and control microcomputer 32 grade, as shown in drawing 1 .
[0026] That is, as shown in drawing 1 , it has input terminal 1a for inputting the video signal of the image source to display into a liquid crystal projector, and the input video signal supplied through this input terminal 1a is supplied to image circuit 11A as a main circuit established in the body 1 interior.
[0027] Image circuit 11A is made to amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, in order to usually reproduce the image based on an input video signal correctly, or a processing circuit required to amend the liquid crystal drive circuit which has functions, such as performing the alternating current drive for the reinforcement of liquid crystal, and a keystone distortion etc. becomes main, and it is constituted. That is, by performing signal processing required in order to display the image based on an input video signal on the screen of the liquid crystal panel 5 used for this liquid crystal projector to an input video signal, this image circuit 11A acquires the panel driving signal according to an input video signal, and gives it to a liquid crystal panel 5. Thereby, the image screen based on an input video signal is displayed on the screen of a liquid crystal panel 5. Moreover, the amendment image screen where processing required to amend the keystone distortion which is giving the panel driving signal of a mitigation **** sake to a liquid crystal panel 5, and produced the keystone distortion of the projection screen 10 on the projection screen 10 in the screen of a liquid crystal panel 5 was performed is displayed by processing image processing circuit 11A to an input video signal for generating a keystone distortion with the reverse projection screen 10, when the keystone distortion has occurred on the projection screen 10.
[0028] On the other hand, the light 4 irradiated from the light source 3 using the reflector etc. penetrates the screen of a liquid crystal panel 5, and the transmitted light 7 of the transmitted liquid crystal panel 5 is narrowed down with a condensing lens 6, and it expands and displays it on a screen 9 by carrying out expansion projection with a projector lens 2. By this, on a screen 9, the image screen displayed on said liquid crystal panel will be formed as a projection screen 10.
[0029] However, as the conventional technique described, it originates in a viewer viewing and listening to the projection screen behind behind a body 1, and if a body 1 is installed so that a body 1 may not interrupt a viewer's field of view, by the gap of whenever [resulting from the installation condition of the liquid crystal projector body 1 / angle-of-projection], a keystone distortion will occur on a projection screen and it will become the display image which is hard to

see.
[0030] Then, in the gestalt of this operation, using image circuit 11A (the image circuit 11 and abbreviation in drawing 7 the same configuration) as a means to amend such a keystone distortion, the outgoing radiation light of a projector lens 2 is made to generate a keystone distortion contrary to a projection screen according to extent of a keystone distortion, and the amendment approach amended so that the keystone distortion of a projection screen may be mitigated is adopted.
[0031] It is the approach of amending the keystone distortion of a projection screen by displaying the image screen which has a keystone distortion in the screen of a liquid crystal panel 5 by the amendment approach using this image circuit 11A by image circuit 11A shown in drawing 1 , and carrying out expansion projection of this. That is, the keystone distortion of a projection screen is amended as a result by adjusting processing by image circuit 11A.
[0032] According to the include angle of a keystone distortion, a black signal part is lessened and is expressed as a fixed rate as a black signal (non-video signal) is specifically displayed every [one line or] several lines at the time of horizontal scanning initiation and termination as shown in drawing 3 , and a vertical scanning progresses. for example, said liquid crystal panel 5 consists of numbers of pixels of an M pixel (level) xN pixel (perpendicular) — having — the left from the lower right of drawing — moreover, in one line at the time of vertical-scanning initiation, if it shall scan upwards from the bottom Every black signal part q pixel is displayed at the time of horizontal scanning initiation and termination, and the M-2q pixel image data which thinned out M-pixel data by 2q pixel are displayed between black signal parts. In L lines to which the vertical scanning of several lines progressed, the p-pixel non-signal section fewer than q pixels is displayed. p pixels in this case are p=q (N-L) / N pixel. The relational expression to say can show. A graphic display part displays the M-2p pixel image data thinned out by 2p pixel. And as shown all over drawing, a black signal part is not displayed in N Rhine in vertical-scanning last Rhine. It is possible to amend the keystone distortion of a projection screen by displaying by this the movie screen which has a keystone distortion in the screen of a liquid crystal panel 5.
[0033] Thus, the timing chart for the concrete configuration of image circuit 11A required to control the display action of a liquid crystal panel 5 being shown in drawing 4 , and explaining the control action of this image circuit 11A of drawing 1 is shown in drawing 5 , and explains concrete actuation hereafter.
[0034] In image circuit 11A, the video signal inputted through input terminal 11a as shown in drawing 4 is supplied to A/D-converter 11b, is that sampling processing is performed by this A/D-converter 11b with the sample clock (refer to drawing 5 (a)) from 11d of control signal generating circuits, and is changed into the digitized image data (it is also called pixel data) which consist of MxN pixels. Then, this image data is written in memory 11c to the timing based on the write-in control signal of the same timing as said sampling clock (refer to drawing 5 (b), (d), and (f)).
[0035] In the next field, the pixel data written in each Rhine are read to different timing from said write-in control signal based on the read-out control signal from 11d of control signal generating circuits, and are supplied to D/A-converter 11e. That is, write-in control and read-out control of the image data to memory are possible for 11d of control signal generating circuits, and they can thin out the image data of each Rhine free by changing such timing.
[0036] D/A-converter 11e is again returned to an analog signal to the timing of the sample clock from 11d of control signal generating circuits, and gives the returned video signal to 11f of liquid crystal drive circuits. By making it amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, and processing polarity-reversals processing for performing an alternating current drive after that etc., the panel driving signal according to a video signal is generated, and the image based on an input video signal is displayed on the screen of a liquid crystal panel 5 by a liquid crystal panel 5 being supplied in 11f of liquid crystal drive circuits.
[0037] At this time, the amount of the sample clock 1 - q piece (pixel) does not read 11d of control signal generating circuits from scan initiation, but they are controlled by one line to display a black signal. M-2 [and] thinned out until [2 / q] it read the first pixel data 1 to the

q+1st piece and read the last pixel data M by eye a M-q individual — the data for q pixels are read. After it, q pixels is not read again but it controls to display a black signal (refer to drawing 5 (c)).
[0038] Similarly, the amount of the sample clock 1 - p piece (pixel) does not read from scan initiation, but it controls by L lines to which the vertical scanning progressed to display a black signal (refer to drawing 5 (c)). M-2 [and] which thinned out 2p pixel until it reads the first pixel data to the p+1st piece and reads the last pixel data M by eye a sample clock M-p individual — it controls to read the data for p pixels. 11d of control signal generating circuits does not read p pixels again, but they control it by timing after it to display a black signal (refer to drawing 5 (e)).
[0039] In N Rhine of the vertical-scanning last, a non-signal part is not displayed, but M written-in data are read as they are, and the image based on the read image data is displayed on the screen of a liquid crystal panel 5 by supplying a liquid crystal panel 5.
[0040] As mentioned above, he is trying to generate a reverse keystone distortion required to amend the keystone distortion produced on the projection screen by the described control action on the screen of a liquid crystal panel.
[0041] However, automatic amendment cannot be carried out in the amendment processing of only image circuit 11A mentioned above.
[0042] Then, the 1st and 2nd distance robots 30 and 31 required of the gestalt of this operation in order to perform automatically keystone distortion amendment processing by the above-mentioned image circuit 11A, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. In order to form the display image of the liquid crystal panel which has a keystone distortion contrary to the keystone distortion of the projection screen 10 based on a calculation result with a sufficient precision, the control microcomputer 32 which controls processing by the aforementioned image circuit 11A is formed.
[0043] Actuation of the keystone distortion amendment by control of this control microcomputer 32 is explained also with reference to drawing 2 .
[0044] the [said] — the 1st and 2nd distance robots 30 and 31 are arranged in the vertical direction by the side of the front face 2 of this projector body 1, i.e., a projector lens, respectively, and are prepared in it. By carrying out outgoing radiation of the light, respectively, for example, and receiving the reflected light of the light, these 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to the control microcomputer 32 by making a measurement result into an electrical signal, respectively. In addition, as long as it seems that each distance is acquired even if it is not a thing using light as the 1st and 2nd distance robots 30 and 31, you may constitute using other sensors.
[0045] The control microcomputer 32 is a control microcomputer which controls the system of a liquid crystal projector at large, and when the measurement result from said 1st and 2nd distance robots 30 and 31 is supplied, it carries out adjustment control of the processing by said image circuit 11A based on the supplied measurement result that the keystone distortion produced on the projection screen 10 should be amended.
[0046] For example, after the control microcomputer 32 computes theta whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31 and carries out data processing of the configuration of that keystone distortion based on this calculation result, it controls processing by the aforementioned image circuit 11A so that the panel driving signal used as a keystone distortion with the reverse keystone distortion of the projection screen 10 is acquired based on this data-processing result. Calculation of whenever [with the control microcomputer 32 at this time / tilt-angle] is tantheta=d/(D1-D2), when whenever [tilt-angle / of a body 1 and a screen 9] is set to theta and the dip of the normal projection screen 10 is set to d (equivalent to the distance between each sensor parallel light D [D1 and] 2 when sensor parallel light of the light of each sensors 30 and 31 is carried out), as shown in drawing 2 . — (formula 1)
Coming out and asking is possible.
[0047] Moreover, by giving a control signal for the control to image processing circuit 11A with

the control microcomputer 32 generating the reverse keystone distortion based on a data-processing result to 11d (referring to drawing 4) of control signal generating circuits in image circuit 11A, 11d of these control signal generating circuits answers this, and they are controlled to change the timing of the read-out control signal of each Rhine. By adjusting the pixel data for every Rhine which used by this memory 11c (refer to drawing 4) which was explained by drawing 3 thru/or drawing 5 It becomes possible to obtain the panel display screen which has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10. It becomes possible to amend automatically and certainly the keystone distortion of the projection screen 10 which originates in whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.

[0048] Therefore, it becomes possible to amend the keystone distortion which did not perform complicated actuation of a user with the gestalt of this operation, but also produced ** on the projection screen automatically and certainly, and offer of the highly efficient front projection mold liquid crystal projector from which the high liquid crystal projection image of the grace which stopped the keystone distortion is acquired can be realized.

[0049] Next, the gestalt of other operations of the keystone distortion compensator of this invention is explained to a detail using drawing 6 .

[0050] Drawing 6 is the block diagram showing the example of a configuration of the liquid crystal projector incorporating the keystone distortion compensator of the gestalt of other operations of this invention.

[0051] It is the point that having constituted from a gestalt of this operation so that keystone distortion amendment might be automatically performed by making it apply to the amendment approach which amends a keystone distortion optically instead of the electric keystone distortion amendment approach in a gestalt of said operation differs from the gestalt of said operation.

[0052] The 1st and 2nd distance robots 30 and 31 which are the descriptions of this invention as a concrete configuration, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. Based on the calculation result, control microcomputer 32A which controls whenever [tilt-angle / of a condensing lens 6] so that the transmitted light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 is incorporated, respectively, and is constituted.

[0053] The include-angle adjusting device 20 used as the main circuits shown in drawing 6 adjusts the inclination of the condensing lens 6 very thing by controlling the driving means (not shown) with which the condensing lens 6 was equipped. That is, by leaning the inclination of a condensing lens 6 like the wavy line 21 shown all over drawing, as the transmitted light of a liquid crystal panel 5 is made to produce a keystone distortion contrary to a projection screen, the keystone distortion of a projection screen is amended as a result.

[0054] the gestalt of this operation — the above — in order to perform optical keystone distortion amendment automatically, by carrying out outgoing radiation of the light like the gestalt of said operation, respectively, and receiving the reflected light of the light, the 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to control microcomputer 32A by making a measurement result into an electrical signal, respectively.

[0055] Control microcomputer 32A computes whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31. By giving a control signal with which the light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 to the include-angle adjusting device 20 based on this data-processing result, after carrying out data processing of the configuration of that keystone distortion based on this calculation result The include-angle adjusting device 20 carries out adjustment control of the inclination of a condensing lens 6 at the optimal include angle, as this is answered and it is shown in a wavy line 21.

[0056] Thereby, since the inclination of a condensing lens 6 is adjusted according to the configuration of the keystone distortion, the transmitted light of a liquid crystal panel becomes

what has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10, and can amend automatically and certainly the keystone distortion of the projection screen 10 which originates in theta whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.
[0057] Moreover, it is also possible to apply to the amendment approach of other optical keystone distortions in this invention. The gestalt of such operation is explained to a detail, referring to drawing 7 .
[0058] Drawing 7 is the block diagram showing the example of a configuration of the liquid crystal projector incorporating the keystone distortion compensator of the gestalt of other operations of this invention.
[0059] with the gestalt of this operation, although it is the same as that of the optical keystone distortion amendment approach explained with the gestalt of said operation almost, the inclination of a condensing lens is not controlled at the optimal include angle, and a keystone distortion is amended for liquid crystal panel 5 the very thing -- it is the point that having constituted so that keystone distortion amendment might be automatically performed at the optimal required include angle by carrying out adjustment control differs from the gestalt of said operation.
[0060] The 1st and 2nd distance robots 30 and 31 which are the descriptions of this invention as a concrete configuration, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. Based on the calculation result, control microcomputer 32B which controls whenever [tilt-angle / of a liquid crystal panel 5] so that the transmitted light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 is incorporated, respectively, and is constituted.
[0061] When the include-angle adjusting device 22 used as the main circuits shown in drawing 7 controls the driving means (not shown) with which the liquid crystal panel 5 was equipped, the inclination of the liquid crystal panel 5 very thing is adjusted. That is, by leaning the inclination of a liquid crystal panel 5 like the wavy line 23 shown all over drawing, as the transmitted light of a liquid crystal panel 5 is made to produce a keystone distortion contrary to a projection screen, the keystone distortion of a projection screen is amended as a result.
[0062] the gestalt of this operation -- the above -- in order to perform optical keystone distortion amendment automatically, by carrying out outgoing radiation of the light like the gestalt of said operation, respectively, and receiving the reflected light of the light, the 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to control microcomputer 32B by making a measurement result into an electrical signal, respectively.
[0063] Control microcomputer 32B computes whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31. By giving a control signal to the include-angle adjusting device 22 based on this data-processing result so that the light of a liquid crystal panel may serve as a keystone distortion contrary to the keystone distortion of the projection screen 10 after carrying out data processing of the configuration of that keystone distortion based on this calculation result The include-angle adjusting device 22 carries out adjustment control of the inclination of a liquid crystal panel 5 at the optimal include angle, as this is answered and it is shown in a wavy line 23.
[0064] Thereby, since the inclination of a liquid crystal panel 5 is adjusted according to the configuration of the keystone distortion, the transmitted light of a liquid crystal panel becomes what has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10, and can amend automatically and certainly the keystone distortion of the projection screen 10 which originates in theta whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.
[0065] Therefore, according to the gestalt of this operation, the same effectiveness as the gestalt of said operation is acquired.
[0066] In addition, it sets in the gestalt of each operation concerning this invention. Data processing is performed so that a keystone distortion configuration contrary to the keystone

distortion configuration produced on the projection screen with the control microcomputers 32, 32A, and 32B based on the calculation result from the 1st and 2nd distance robots 30 and 31 may be acquired. Although it explained that keystone distortion amendment processing was performed by controlling an image circuit or the include-angle adjusting devices 20 and 22 based on this data-processing result for example, prepare the table memory which memorized the configuration data of a keystone distortion according to whenever [tilt-angle / of the screen to a body] beforehand in each control microcomputer, and in carrying out keystone distortion amendment With reference to said this table memory, the keystone distortion configuration data corresponding to the calculation result from said 1st and 2nd distance robots 30 and 31 may be obtained, and an image circuit or an include-angle adjusting device may be controlled based on this acquired keystone distortion configuration, and you may constitute so that keystone distortion amendment may be performed.

[0067]

[Effect of the Invention] As mentioned above, offer of the highly efficient front projection mold liquid crystal projector from which the high liquid crystal projection image of the grace which according to this invention did not need the complicated remedial operation by the user, but became possible [amending the keystone distortion produced on the projection screen automatically and certainly] as stated, consequently stopped the keystone distortion is acquired is realizable.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the keystone distortion compensator which amends the keystone distortion which originates in the installation condition of a front projection mold liquid crystal projector, and is produced on the projection image, and relates to the keystone distortion compensator which does not need the troublesome manual operation by the ** user, but can amend a keystone distortion automatically and the optimal.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In recent years, development of the liquid crystal projector using a liquid crystal panel is briskly performed with the demand of a small and lightweight display unit by the big screen. Since big-screen-izing is easy, the liquid crystal projector is expected also as an object for high definition televisions.
[0003] especially it can be used, the liquid crystal projector of a front projection mold being able to be small and lightweight, and installing it simply, and since it is not so expensive in cost, a user enjoys popularity in recent years — it has both spread broadly and future need is also fully expected.
[0004] Therefore, in order to satisfy a demand of such a user, not to mention acquiring the projection image which was excellent in the liquid crystal projector of a front projection mold, without dropping the grace of the projection image, even when distortion etc. occurs on the projection image, it is temporarily required for it to have immediately the function which can be amended, and it is desirable for the amendment engine performance to be highly precise.
[0005] An example of the liquid crystal projector of the conventional common front projection mold equipped with such an amendment function is shown in drawing 8 .
[0006] As shown in drawing 8 , it has input terminal 1a for inputting the video signal of the image source to display into a liquid crystal projector, and the input video signal supplied through this input terminal 1a is supplied to the image circuit 11 as a main circuit established in the body 1 interior.
[0007] The image circuit 11 is made to amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, in order to usually reproduce the image based on an input video signal correctly, or a processing circuit required to amend the liquid crystal drive circuit which has functions, such as performing the alternating current drive for the reinforcement of liquid crystal, and a keystone distortion etc. becomes main, and it is constituted. That is, by performing signal processing required in order to display the image based on an input video signal on the screen of the liquid crystal panel 5 used for this liquid crystal projector to an input video signal, the image circuit 11 acquires the panel driving signal according to an input video signal, and gives it to a liquid crystal panel 5. Thereby, the image screen based on an input video signal is displayed on the screen of a liquid crystal panel 5.
[0008] On the other hand, the light 4 irradiated from the light source 3 using the reflector etc. penetrates the screen of a liquid crystal panel 5, and the transmitted light 7 of the transmitted liquid crystal panel 5 is narrowed down with a condensing lens 6, and it expands and displays it on a screen 9 by carrying out expansion projection with a projector lens 2. By this, on a screen 9, the image screen displayed on said liquid crystal panel will be formed as a projection screen 10.
[0009] By the way, generally, since a viewer views and listens to the projection screen behind behind a body 1 in many cases, such a front projection mold liquid crystal projector may be installed so that a body 1 may not interrupt a viewer's field of view. That is, a body 1 will be installed at the include angle projected so that a projection screen may be located in the body 1 upper part. However, in such a case, the projection screen 10 with distortion generally called keystone distortion (called keystone distortion) will be formed by the gap of whenever [angle-

of-projection / which originated in the installation condition of the liquid crystal projector body 1 as shown in drawing 9].

[0010] As a means to amend such a keystone distortion, generally there are two approaches, it is the amendment approach in which one carries out keystone distortion amendment electrically, and another is the amendment approach which carries out keystone distortion amendment optically.

[0011] The approach of carrying out keystone distortion amendment electrically is the approach of amending the keystone distortion of a projection screen by displaying the image screen which has a keystone distortion contrary to a projection image in the screen of a liquid crystal panel 5 by the image circuit 11, and carrying out expansion projection of this.

[0012] Another approach of carrying out keystone distortion amendment optically is the approach of amending the keystone distortion of a projection screen by adjusting the inclination of a condensing lens 6 within the liquid crystal projector body 1.

[0013] Or a keystone distortion can be amended by adopting the structure where a condensing lens 6 is not leaned but liquid crystal panel 5 the very thing is leaned.

[0014] However, by the conventional electric and optical keystone distortion amendment approach mentioned above, there was a trouble that the contents of actuation were complicated and it could not carry out easily from it being what all performs the amendment by actuation of a user since delicate level adjustment etc. is required in order to carry out keystone distortion amendment certainly.

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, offer of the highly efficient front projection mold liquid crystal projector from which the high liquid crystal projection image of the grace which according to this invention did not need the complicated remedial operation by the user, but became possible [amending the keystone distortion produced on the projection screen automatically and certainly] as stated, consequently stopped the keystone distortion is acquired is realizable.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Although it had amended by the conventional keystone distortion amendment approach like the above so that the keystone distortion which the transmitted light of the input video signal itself or a liquid crystal panel was made to generate a keystone distortion contrary to a projection screen electrically or optically, and was produced on the projection screen might be mitigated By these approaches, there was a trouble that the contents of actuation were complicated and it could not carry out easily from it being what all performs the amendment by actuation of a user since delicate level adjustment etc. is required in order to carry out keystone distortion amendment certainly.
[0016] Then, this invention was made in view of the above-mentioned problem, and does not need the complicated remedial operation by the user, but aims at offer of the keystone distortion compensator which can amend the keystone distortion produced on the projection screen automatically and certainly.

[Translation done.]

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MEANS

[Means for Solving the Problem] The keystone distortion compensator by invention according to claim 1 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] It is the processing circuit which performs processing for making the image based on said input video signal form on said liquid crystal panel side. By having the memory which memorizes the pixel data corresponding to an input video signal, and changing the writing for every Rhine of the pixel data of this memory, and the timing of read-out Based on the detection result from the image processing circuit which can infanticide adjust pixel data and said distance detection means for every Rhine, the tilt angle of said body of a liquid crystal display over said screen is computed. The amendment control means which controls said image processing circuit automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.
[0018] According to this invention, the distance of this body of a liquid crystal display and said screen is detected by the distance detection means formed in the location where said front faces of the body of a liquid crystal display differ, respectively. [two or more] Infanticide adjustment of the pixel data for every Rhine is possible for said image processing circuit by being the processing circuit which performs processing for making the image based on said input video signal form on said liquid crystal panel side, having the memory which memorizes the pixel data corresponding to an input video signal, and changing the writing for every Rhine of the pixel data of this memory, and the timing of read-out. At the time of keystone distortion generating, an amendment control means computes the tilt angle of said body of a liquid crystal display over said screen based on the detection result from said distance detection means, and it controls said image processing circuit automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result. Thereby, since the projection image light of a liquid crystal panel becomes what is contrary to the keystone distortion configuration of said projection screen that carries out keystone distortion ******, a keystone distortion can be mitigated as a result and it becomes possible to perform this keystone distortion amendment automatically moreover.
[0019] The keystone distortion compensator of invention according to claim 2 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The condensing lens equipped with the driving means to which it is a lens for condensing the projection image light from said liquid crystal panel, and irradiating to a screen through a projector lens, and the tilt

angle of this lens itself is changed free, Said driving means of said condensing lens A controllable include-angle adjustment means, Based on the detection result from said distance detection means, the tilt angle of said body of a liquid crystal display over said screen is computed. The amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.
[0020] According to this invention, the projection image light of a liquid crystal panel which has a keystone distortion configuration contrary to the keystone distortion configuration of said projection screen by controlling said include-angle adjustment means by said amendment control means, and changing the tilt angle of a condensing lens by it is obtained. Thereby, the same effectiveness as the above-mentioned invention is acquired.
[0021] The keystone distortion compensator of invention according to claim 3 In the liquid crystal display which projects the formation image on the liquid crystal panel side formed based on the input video signal by the exposure light from the light source, and carries out the enlarged display of the projection image light on a screen through an optical-system means A distance detection means to be formed in the location where said front faces of the body of a liquid crystal display differ, to detect the distance of this body of a liquid crystal display, and said screen, respectively, and to output a detection result, [two or more] The liquid crystal panel equipped with the driving means to which the tilt angle of said liquid crystal panel itself is changed free, Based on the detection result from a controllable include-angle adjustment means and said distance detection means, the tilt angle of said body [as opposed to said screen for said driving means of said liquid crystal panel] of a liquid crystal display is computed. The amendment control means which controls said include-angle adjustment means automatically so that the keystone distortion of the projection screen resulting from the tilt angle of said body of a liquid crystal display may be amended based on this calculation result is provided.
[0022] According to this invention, the projection image light of a liquid crystal panel which has a keystone distortion configuration contrary to the keystone distortion configuration of said projection screen by controlling said include-angle adjustment means by said amendment control means, and changing the tilt angle of a liquid crystal panel by it is obtained. Thereby, the same effectiveness as the above-mentioned invention is acquired.
[0023]
[Embodiment of the Invention] The gestalt of implementation of invention is explained with reference to a drawing. Drawing 1 is the block diagram in which showing the gestalt of 1 operation of the keystone distortion compensator of this invention, and showing the example of a configuration of the liquid crystal projector of the front projection mold constituted by incorporating this equipment.
[0024] In order to amend automatically the keystone distortion of the projection screen which originates in the installation condition of the liquid crystal projector of a front projection mold, and is produced with the gestalt of this operation The 1st and 2nd distance robots 30 and 31 as a distance detection means which detect distance with a screen 9 up and down the front-face side of the liquid crystal projector body 1, respectively are formed. He is trying to attain the purpose by performing processing in the image circuit used with the conventional technique based on the detection result obtained by these 1st and 2nd distance robots 30 and 31.
[0025] The front projection mold liquid crystal projector which incorporated the keystone distortion compensator of the gestalt of this operation as a concrete whole configuration has the description in the point of having prepared the 1st and 2nd distance robots 30 and 31 of the above, and control microcomputer 32 grade, as shown in drawing 1 .
[0026] That is, as shown in drawing 1 , it has input terminal 1a for inputting the video signal of the image source to display into a liquid crystal projector, and the input video signal supplied through this input terminal 1a is supplied to image circuit 11A as a main circuit established in the body 1 interior.
[0027] Image circuit 11A is made to amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, in order to usually reproduce the image based on an input video signal correctly, or a processing circuit required to amend the liquid crystal drive

circuit which has functions, such as performing the alternating current drive for the reinforcement of liquid crystal, and a keystone distortion etc. becomes main, and it is constituted. That is, by performing signal processing required in order to display the image based on an input video signal on the screen of the liquid crystal panel 5 used for this liquid crystal projector to an input video signal, this image circuit 11A acquires the panel driving signal according to an input video signal, and gives it to a liquid crystal panel 5. Thereby, the image screen based on an input video signal is displayed on the screen of a liquid crystal panel 5. Moreover, the amendment image screen where processing required to amend the keystone distortion which is giving the panel driving signal of a mitigation **** sake to a liquid crystal panel 5, and produced the keystone distortion of the projection screen 10 on the projection screen 10 in the screen of a liquid crystal panel 5 was performed is displayed by processing image processing circuit 11A to an input video signal for generating a keystone distortion with the reverse projection screen 10, when the keystone distortion has occurred on the projection screen 10.

[0028] On the other hand, the light 4 irradiated from the light source 3 using the reflector etc. penetrates the screen of a liquid crystal panel 5, and the transmitted light 7 of the transmitted liquid crystal panel 5 is narrowed down with a condensing lens 6, and it expands and displays it on a screen 9 by carrying out expansion projection with a projector lens 2. By this, on a screen 9, the image screen displayed on said liquid crystal panel will be formed as a projection screen 10.

[0029] However, as the conventional technique described, it originates in a viewer viewing and listening to the projection screen behind behind a body 1, and if a body 1 is installed so that a body 1 may not interrupt a viewer's field of view, by the gap of whenever [resulting from the installation condition of the liquid crystal projector body 1 / angle-of-projection], a keystone distortion will occur on a projection screen and it will become the display image which is hard to see.

[0030] Then, in the gestalt of this operation, using image circuit 11A (the image circuit 11 and abbreviation in drawing 7 the same configuration) as a means to amend such a keystone distortion, the outgoing radiation light of a projector lens 2 is made to generate a keystone distortion contrary to a projection screen according to extent of a keystone distortion, and the amendment approach amended so that the keystone distortion of a projection screen may be mitigated is adopted.

[0031] It is the approach of amending the keystone distortion of a projection screen by displaying the image screen which has a keystone distortion in the screen of a liquid crystal panel 5 by the amendment approach using this image circuit 11A by image circuit 11A shown in drawing 1 , and carrying out expansion projection of this. That is, the keystone distortion of a projection screen is amended as a result by adjusting processing by image circuit 11A.

[0032] According to the include angle of a keystone distortion, a black signal part is lessened and is expressed as a fixed rate as a black signal (non-video signal) is specifically displayed every [one line or] several lines at the time of horizontal scanning initiation and termination as shown in drawing 3 , and a vertical scanning progresses. for example, said liquid crystal panel 5 consists of numbers of pixels of an M pixel (level) xN pixel (perpendicular) — having — the left from the lower right of drawing — moreover, in one line at the time of vertical-scanning initiation, if it shall scan upwards from the bottom Every black signal part q pixel is displayed at the time of horizontal scanning initiation and termination, and the M-2q pixel image data which thinned out M-pixel data by 2q pixel are displayed between black signal parts. In L lines to which the vertical scanning of several lines progressed, the p-pixel non-signal section fewer than q pixels is displayed. p pixels in this case are p=q (N-L) / N pixel. The relational expression to say can show. A graphic display part displays the M-2p pixel image data thinned out by 2p pixel. And as shown all over drawing, a black signal part is not displayed in N Rhine in vertical-scanning last Rhine. It is possible to amend the keystone distortion of a projection screen by displaying by this the movie screen which has a keystone distortion in the screen of a liquid crystal panel 5.

[0033] Thus, the timing chart for the concrete configuration of image circuit 11A required to control the display action of a liquid crystal panel 5 being shown in drawing 4 , and explaining the

control action of this image circuit 11A of drawing 1 is shown in drawing 5 , and explains concrete actuation hereafter.
[0034] In image circuit 11A, the video signal inputted through input terminal 11a as shown in drawing 4 is supplied to A/D-converter 11b, is that sampling processing is performed by this A/D-converter 11b with the sample clock (refer to drawing 5 (a)) from 11d of control signal generating circuits, and is changed into the digitized image data (it is also called pixel data) which consist of MxN pixels. Then, this image data is written in memory 11c to the timing based on the write-in control signal of the same timing as said sampling clock (refer to drawing 5 (b), (d), and (f)).
[0035] In the next field, the pixel data written in each Rhine are read to different timing from said write-in control signal based on the read-out control signal from 11d of control signal generating circuits, and are supplied to D/A-converter 11e. That is, write-in control and read-out control of the image data to memory are possible for 11d of control signal generating circuits, and they can thin out the image data of each Rhine free by changing such timing.
[0036] D/A-converter 11e is again returned to an analog signal to the timing of the sample clock from 11d of control signal generating circuits, and gives the returned video signal to 11f of liquid crystal drive circuits. By making it amplify to an electrical potential difference required to drive a liquid crystal panel 5 to an input video signal, and processing polarity-reversals processing for performing an alternating current drive after that etc., the panel driving signal according to a video signal is generated, and the image based on an input video signal is displayed on the screen of a liquid crystal panel 5 by a liquid crystal panel 5 being supplied in 11f of liquid crystal drive circuits.
[0037] At this time, the amount of the sample clock 1 - q piece (pixel) does not read 11d of control signal generating circuits from scan initiation, but they are controlled by one line to display a black signal. M-2 [and] thinned out until [2 / q] it read the first pixel data 1 to the q+1st piece and read the last pixel data M by eye a M-q individual -- the data for q pixels are read. After it, q pixels is not read again but it controls to display a black signal (refer to drawing 5 (c)).
[0038] Similarly, the amount of the sample clock 1 - p piece (pixel) does not read from scan initiation, but it controls by L lines to which the vertical scanning progressed to display a black signal (refer to drawing 5 (c)). M-2 [and] which thinned out 2p pixel until it reads the first pixel data to the p+1st piece and reads the last pixel data M by eye a sample clock M-p individual -- it controls to read the data for p pixels. 11d of control signal generating circuits does not read p pixels again, but they control it by timing after it to display a black signal (refer to drawing 5 (e)).
[0039] In N Rhine of the vertical-scanning last, a non-signal part is not displayed, but M written-in data are read as they are, and the image based on the read image data is displayed on the screen of a liquid crystal panel 5 by supplying a liquid crystal panel 5.
[0040] As mentioned above, he is trying to generate a reverse keystone distortion required to amend the keystone distortion produced on the projection screen by the described control action on the screen of a liquid crystal panel.
[0041] However, automatic amendment cannot be carried out in the amendment processing of only image circuit 11A mentioned above.
[0042] Then, the 1st and 2nd distance robots 30 and 31 required of the gestalt of this operation in order to perform automatically keystone distortion amendment processing by the above-mentioned image circuit 11A, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. In order to form the display image of the liquid crystal panel which has a keystone distortion contrary to the keystone distortion of the projection screen 10 based on a calculation result with a sufficient precision, the control microcomputer 32 which controls processing by the aforementioned image circuit 11A is formed.
[0043] Actuation of the keystone distortion amendment by control of this control microcomputer 32 is explained also with reference to drawing 2 .
[0044] the [said] -- the 1st and 2nd distance robots 30 and 31 are arranged in the vertical direction by the side of the front face 2 of this projector body 1, i.e., a projector lens,

respectively, and are prepared in it. By carrying out outgoing radiation of the light, respectively, for example, and receiving the reflected light of the light, these 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to the control microcomputer 32 by making a measurement result into an electrical signal, respectively. In addition, as long as it seems that each distance is acquired even if it is not a thing using light as the 1st and 2nd distance robots 30 and 31, you may constitute using other sensors.

[0045] The control microcomputer 32 is a control microcomputer which controls the system of a liquid crystal projector at large, and when the measurement result from said 1st and 2nd distance robots 30 and 31 is supplied, it carries out adjustment control of the processing by said image circuit 11A based on the supplied measurement result that the keystone distortion produced on the projection screen 10 should be amended.

[0046] For example, after the control microcomputer 32 computes theta whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31 and carries out data processing of the configuration of that keystone distortion based on this calculation result, it controls processing by the aforementioned image circuit 11A so that the panel driving signal used as a keystone distortion with the reverse keystone distortion of the projection screen 10 is acquired based on this data-processing result. Calculation of whenever [with the control microcomputer 32 at this time / tilt-angle] is tantheta=d/(D1-D2), when whenever [tilt-angle / of a body 1 and a screen 9] is set to theta and the dip of the normal projection screen 10 is set to d (equivalent to the distance between each sensor parallel light D [D1 and] 2 when sensor parallel light of the light of each sensors 30 and 31 is carried out), as shown in drawing 2 . — (formula 1)
Coming out and asking is possible.

[0047] Moreover, by giving a control signal for the control to image processing circuit 11A with the control microcomputer 32 generating the reverse keystone distortion based on a data-processing result to 11d (referring to drawing 4) of control signal generating circuits in image circuit 11A, 11d of these control signal generating circuits answers this, and they are controlled to change the timing of the read-out control signal of each Rhine. By adjusting the pixel data for every Rhine which used by this memory 11c (refer to drawing 4) which was explained by drawing 3 thru/or drawing 5 It becomes possible to obtain the panel display screen which has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10. It becomes possible to amend automatically and certainly the keystone distortion of the projection screen 10 which originates in whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.

[0048] Therefore, it becomes possible to amend the keystone distortion which did not perform complicated actuation of a user with the gestalt of this operation, but also produced ** on the projection screen automatically and certainly, and offer of the highly efficient front projection mold liquid crystal projector from which the high liquid crystal projection image of the grace which stopped the keystone distortion is acquired can be realized.

[0049] Next, the gestalt of other operations of the keystone distortion compensator of this invention is explained to a detail using drawing 6 .

[0050] Drawing 6 is the block diagram showing the example of a configuration of the liquid crystal projector incorporating the keystone distortion compensator of the gestalt of other operations of this invention.

[0051] It is the point that having constituted from a gestalt of this operation so that keystone distortion amendment might be automatically performed by making it apply to the amendment approach which amends a keystone distortion optically instead of the electric keystone distortion amendment approach in a gestalt of said operation differs from the gestalt of said operation.

[0052] The 1st and 2nd distance robots 30 and 31 which are the descriptions of this invention as a concrete configuration, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. Based on the calculation result, control microcomputer 32A which controls whenever [tilt-angle / of a

condensing lens 6] so that the transmitted light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 is incorporated, respectively, and is constituted.
[0053] The include-angle adjusting device 20 used as the main circuits shown in drawing 6 adjusts the inclination of the condensing lens 6 very thing by controlling the driving means (not shown) with which the condensing lens 6 was equipped. That is, by leaning the inclination of a condensing lens 6 like the wavy line 21 shown all over drawing, as the transmitted light of a liquid crystal panel 5 is made to produce a keystone distortion contrary to a projection screen, the keystone distortion of a projection screen is amended as a result.
[0054] the gestalt of this operation — the above — in order to perform optical keystone distortion amendment automatically, by carrying out outgoing radiation of the light like the gestalt of said operation, respectively, and receiving the reflected light of the light, the 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to control microcomputer 32A by making a measurement result into an electrical signal, respectively.
[0055] Control microcomputer 32A computes whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31. By giving a control signal with which the light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 to the include-angle adjusting device 20 based on this data-processing result, after carrying out data processing of the configuration of that keystone distortion based on this calculation result The include-angle adjusting device 20 carries out adjustment control of the inclination of a condensing lens 6 at the optimal include angle, as this is answered and it is shown in a wavy line 21.
[0056] Thereby, since the inclination of a condensing lens 6 is adjusted according to the configuration of the keystone distortion, the transmitted light of a liquid crystal panel becomes what has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10, and can amend automatically and certainly the keystone distortion of the projection screen 10 which originates in theta whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.
[0057] Moreover, it is also possible to apply to the amendment approach of other optical keystone distortions in this invention. The gestalt of such operation is explained to a detail, referring to drawing 7 .
[0058] Drawing 7 is the block diagram showing the example of a configuration of the liquid crystal projector incorporating the keystone distortion compensator of the gestalt of other operations of this invention.
[0059] with the gestalt of this operation, although it is the same as that of the optical keystone distortion amendment approach explained with the gestalt of said operation almost, the inclination of a condensing lens is not controlled at the optimal include angle, and a keystone distortion is amended for liquid crystal panel 5 the very thing — it is the point that having constituted so that keystone distortion amendment might be automatically performed at the optimal required include angle by carrying out adjustment control differs from the gestalt of said operation.
[0060] The 1st and 2nd distance robots 30 and 31 which are the descriptions of this invention as a concrete configuration, Based on the detection result obtained by these 2nd distance robot 30 and 31, whenever [tilt-angle / of the projection screen 10 of a screen 9] is computed. Based on the calculation result, control microcomputer 32B which controls whenever [tilt-angle / of a liquid crystal panel 5] so that the transmitted light of a liquid crystal panel serves as a keystone distortion contrary to the keystone distortion of the projection screen 10 is incorporated, respectively, and is constituted.
[0061] When the include-angle adjusting device 22 used as the main circuits shown in drawing 7 controls the driving means (not shown) with which the liquid crystal panel 5 was equipped, the inclination of the liquid crystal panel 5 very thing is adjusted. That is, by leaning the inclination of a liquid crystal panel 5 like the wavy line 23 shown all over drawing, as the transmitted light of a liquid crystal panel 5 is made to produce a keystone distortion contrary to a projection screen,

the keystone distortion of a projection screen is amended as a result.
[0062] the gestalt of this operation — the above — in order to perform optical keystone distortion amendment automatically, by carrying out outgoing radiation of the light like the gestalt of said operation, respectively, and receiving the reflected light of the light, the 1st and 2nd distance robots 30 and 31 measure the distance D1 and D2 of the front section of a body 1, and a screen 9, and give them to control microcomputer 32B by making a measurement result into an electrical signal, respectively.
[0063] Control microcomputer 32B computes whenever [tilt-angle / of a body 1 and a screen 9] from the measurement result from said 1st and 2nd distance robots 30 and 31. By giving a control signal to the include-angle adjusting device 22 based on this data-processing result so that the light of a liquid crystal panel may serve as a keystone distortion contrary to the keystone distortion of the projection screen 10 after carrying out data processing of the configuration of that keystone distortion based on this calculation result The include-angle adjusting device 22 carries out adjustment control of the inclination of a liquid crystal panel 5 at the optimal include angle, as this is answered and it is shown in a wavy line 23.
[0064] Thereby, since the inclination of a liquid crystal panel 5 is adjusted according to the configuration of the keystone distortion, the transmitted light of a liquid crystal panel becomes what has a keystone distortion contrary to the keystone distortion configuration produced on the projection screen 10, and can amend automatically and certainly the keystone distortion of the projection screen 10 which originates in theta whenever [tilt-angle / of a body 1 and a screen 9] as a result, and is produced according to the generating configuration.
[0065] Therefore, according to the gestalt of this operation, the same effectiveness as the gestalt of said operation is acquired.
[0066] In addition, it sets in the gestalt of each operation concerning this invention. Data processing is performed so that a keystone distortion configuration contrary to the keystone distortion configuration produced on the projection screen with the control microcomputers 32, 32A, and 32B based on the calculation result from the 1st and 2nd distance robots 30 and 31 may be acquired. Although it explained that keystone distortion amendment processing was performed by controlling an image circuit or the include-angle adjusting devices 20 and 22 based on this data-processing result for example, prepare the table memory which memorized the configuration data of a keystone distortion according to whenever [tilt-angle / of the screen to a body] beforehand in each control microcomputer, and in carrying out keystone distortion amendment With reference to said this table memory, the keystone distortion configuration data corresponding to the calculation result from said 1st and 2nd distance robots 30 and 31 may be obtained, and an image circuit or an include-angle adjusting device may be controlled based on this acquired keystone distortion configuration, and you may constitute so that keystone distortion amendment may be performed.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram in which showing the gestalt of 1 operation of the keystone distortion compensator of this invention, and showing the whole liquid crystal projector configuration into which this equipment was built.
[Drawing 2] The explanatory view for explaining the include-angle calculation approach of of a body and a screen with the control microcomputer of drawing 1 .
[Drawing 3] The explanatory view for explaining the amendment approach which amends a keystone distortion electrically.
[Drawing 4] The block diagram showing the example of a configuration of the image circuit for carrying out electric keystone distortion amendment.
[Drawing 5] The timing chart for explaining the writing of the image data to the memory by the image circuit shown in drawing 4 , and read-out control.
[Drawing 6] The block diagram in which showing the keystone distortion compensator of the gestalt of other operations of this invention, and showing the configuration of the liquid crystal projector at the time of applying this equipment to the optical amendment approach.
[Drawing 7] The block diagram in which showing the keystone distortion compensator of the gestalt of other operations of this invention, and showing the configuration of the liquid crystal projector at the time of applying this equipment to the optical amendment approach.
[Drawing 8] The block diagram showing the configuration of a general front projection mold liquid crystal projector.
[Drawing 9] The explanatory view for explaining the generating condition of a keystone distortion.

[Description of Notations]
1 — Liquid crystal projector body,
2 — Projector lens
3 — Light source,
4 — Light,
5 — Liquid crystal panel
6 — Condensing lens,
7 — Panel transmitted light,
8 — Optical axis,
9 — Screen,
10 — Projection screen,
11A — Image circuit,
20 22 — Include-angle adjusting device,
30 — The 1st distance robot (distance detection means),
31 — The 2nd distance robot (distance detection means),
32, 32A, 32B — Control microcomputer (control means).

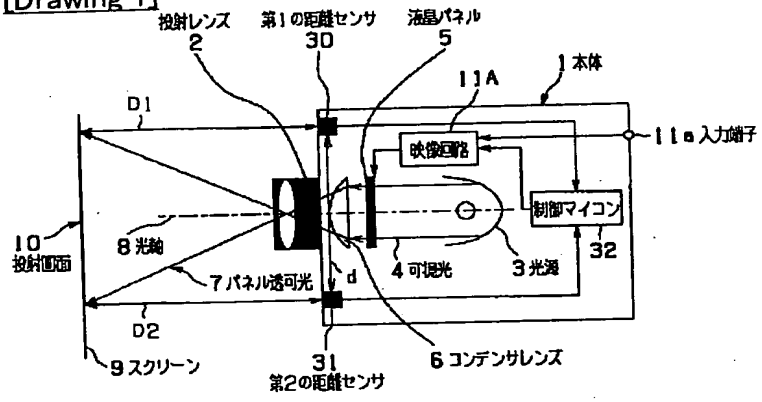
[Translation done.]

* NOTICES *

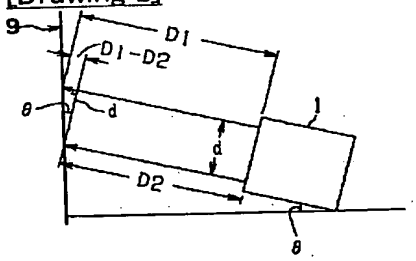
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

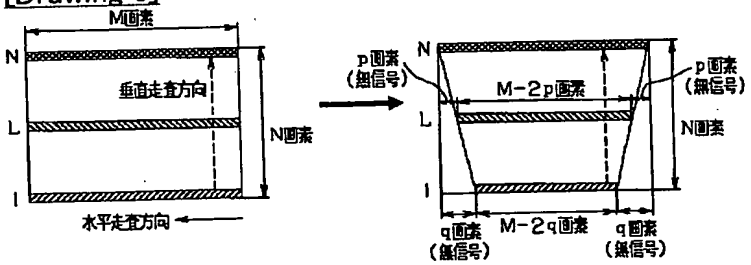
[Drawing 1]



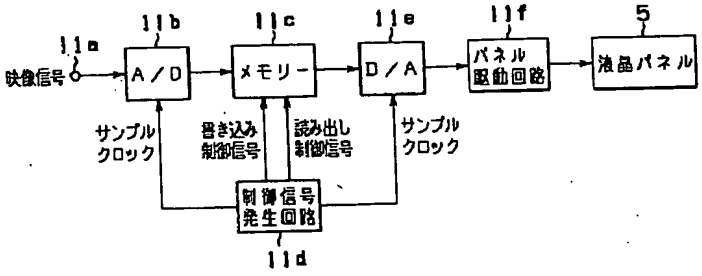
[Drawing 2]



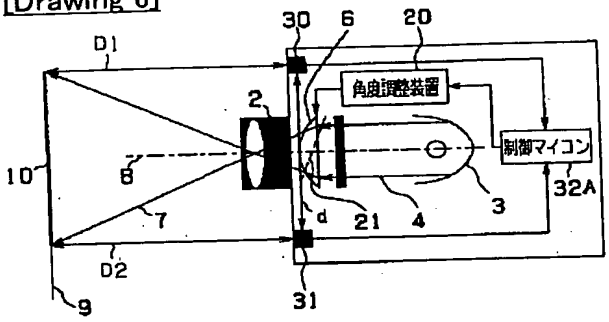
[Drawing 3]



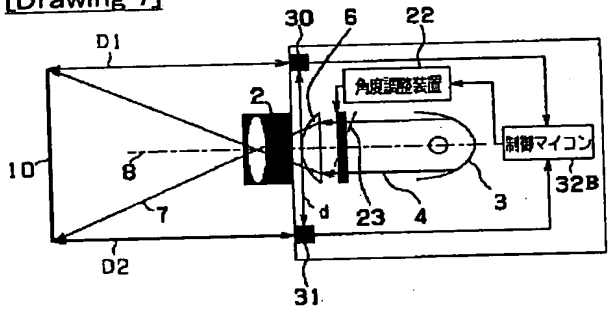
[Drawing 4]



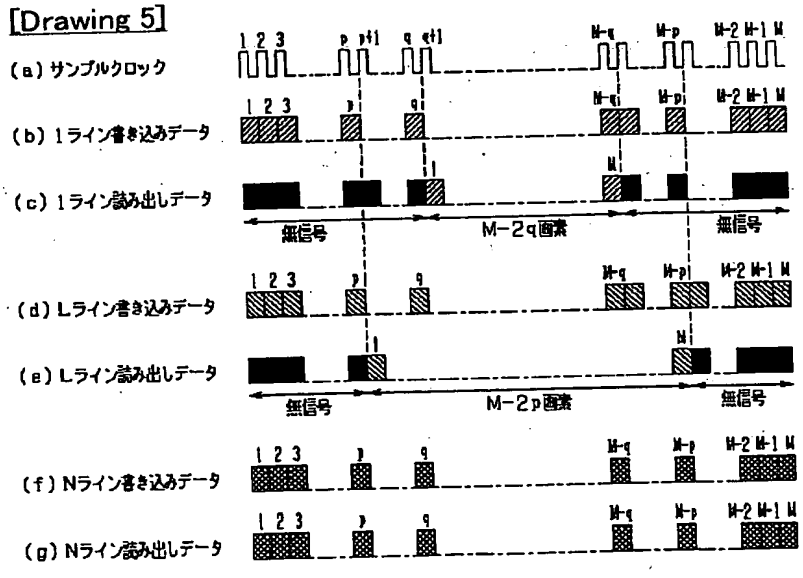
[Drawing 6]



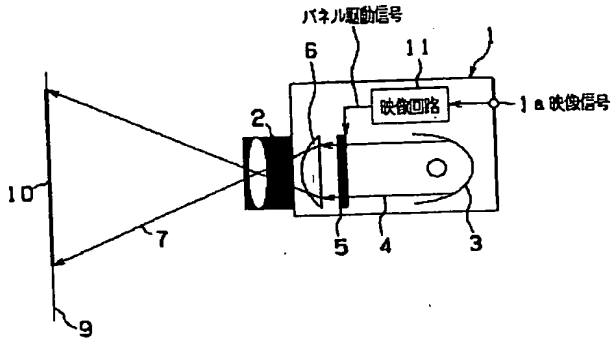
[Drawing 7]



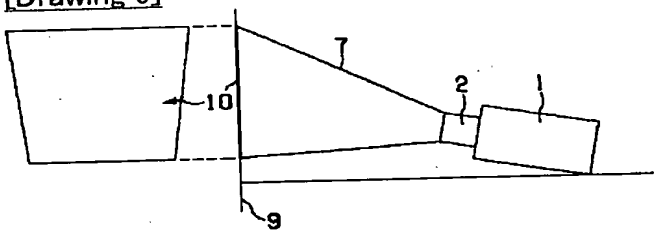
[Drawing 5]



[Drawing 8]



[Drawing 9]



[Translation done.]

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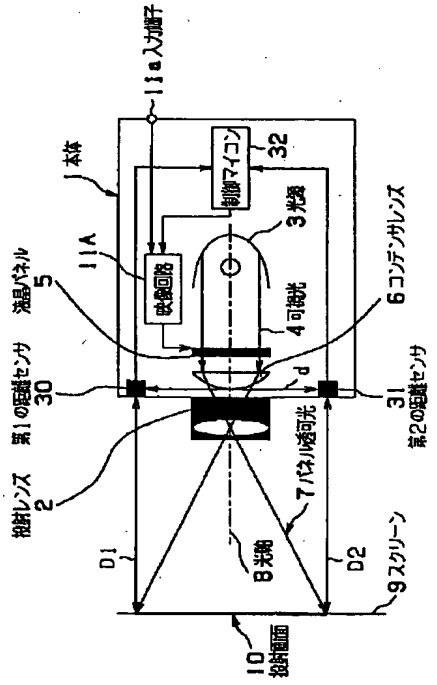
最終頁に続く

(54)【発明の名称】　台形歪み補正装置

(57)【要約】
【課題】　ユーザによる煩雑な補正操作を必要とせず、自動的に且つ確実に投射画面に生じた台形歪みを補正すること。
【解決手段】　液晶プロジェクタ本体１前面の異なる位置に複数設けられた第１及び第２の距離センサ３０，３１は、該本体１とスクリーン９との距離をそれぞれ検出する。制御マイコン３２はこれらの検出結果に基づきスクリーン９に対する本体１の傾斜角を算出し、この算出結果に基づき、液晶パネル５の投射画像光が本体１の傾斜角に起因する投射画面の台形歪み形状とは逆の台形歪み形状となるように、各ライン毎の画素データの間引き調整が可能な映像処理回路１１Ａを制御する。これにより、ユーザの煩雑な操作を必要とせず、自動的に投射画面に生じた台形歪み補正を行うことが可能となる。



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【特許請求の範囲】

【請求項１】　入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、

前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、

前記入力映像信号に基づく画像を前記液晶パネル面上に形成させるための処理を行う処理回路であって、入力映像信号に対応した画素データを記憶するメモリを備え、該メモリの画素データのライン毎の書き込み、読み出しのタイミングを変化させることにより、ライン毎の画素データの間引き調整が可能な映像処理回路と、

前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記映像処理回路を自動制御する補正制御手段と、

を具備したことを特徴とする台形歪み補正装置。

【請求項２】　入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、

前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、

前記液晶パネルからの投射画像光を集光し、投射レンズを介してスクリーンへと照射するためのレンズであって、該レンズ自体の傾斜角を自在に変化させる駆動手段を備えたコンデンサレンズと、

前記コンデンサレンズの前記駆動手段を制御可能な角度調整手段と、

前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記角度調整手段を自動制御する補正制御手段と、

を具備したことを特徴とする台形歪み補正装置。

【請求項３】　入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、

前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、

前記液晶パネル自体の傾斜角を自在に変化させる駆動手段を備えた液晶パネルと、

前記液晶パネルの前記駆動手段を制御可能な角度調整手段と、

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前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記角度調整手段を自動制御する補正制御手段と、

を具備したことを特徴とする台形歪み補正装置。

【請求項４】　前記補正制御手段は、前記算出結果に基づき、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪み形状とは逆の台形歪み形状を有する投射画像光が得られるように前記映像処理回路手段または前記角度調整手段を制御する請求項１乃至請求項３のいずれか一つに記載の台形歪み補正装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、前面投射型液晶プロジェクタの設置状態に起因してその投射映像に生じる台形歪みを補正する台形歪み補正装置に係り、特ユーザによる煩わしい手動操作を必要とせず自動的にしかも最適に台形歪みを補正することのできる台形歪み補正装置に関する。

【０００２】

【従来の技術】近年、大画面で小型・軽量のディスプレイ装置の要求に伴い、液晶パネルを用いた液晶プロジェクタの開発が盛んに行われている。液晶プロジェクタは大画面化が容易であること等から、高品位テレビジョン用としても期待されている。

【０００３】中でも、前面投射型の液晶プロジェクタは、小型・軽量で簡単に設置して使用することができ、またコスト的にもそう高価ではないことから、近年ユーザに人気があるとともに幅広く普及しており、今後の需要も十分に期待されている。

【０００４】したがって、こうしたユーザの要求を満足するためには、前面投射型の液晶プロジェクタでは、その投射映像の品位を落とさずに優れた投射映像を得ることは勿論のこと、仮にその投射映像に歪み等が発生した場合でも即座に補正可能な機能を併せ持つことが必要であり、またその補正性能が高精度であることが望ましい。

【０００５】このような補正機能を備えた従来の一般的な前面投射型の液晶プロジェクタの一例を図８に示す。

【０００６】図８に示すように、液晶プロジェクタには、表示する映像ソースの映像信号を入力するための入力端子１ａを備え、この入力端子１ａを介して供給された入力映像信号は、本体１内部に設けられた主要回路としての映像回路１１に供給される。

【０００７】映像回路１１は、通常、入力映像信号に基づく映像を正確に再現するために、入力映像信号に対し液晶パネル５を駆動するのに必要な電圧まで増幅させたり、液晶の長寿命化のための交流駆動を行う等の機能を有する液晶駆動回路や台形歪みを補正するのに必要な処

理回路等が主となって構成されている。つまり、映像回路１１は、入力映像信号に基づく映像を該液晶プロジェクタに使用される液晶パネル５の表示面に表示するために必要な信号処理を入力映像信号に施すことにより、入力映像信号に応じたパネル駆動信号を得て液晶パネル５に与える。これにより、液晶パネル５の表示面には入力映像信号に基づく映像画面が表示される。

【０００８】一方、リフレクタ等を用いて光源３から照射された可視光４は、液晶パネル５の表示面を透過し、透過した液晶パネル５の透過光７は、コンデンサレンズ６によって絞り込まれ、投射レンズ２によって拡大投射されることによって、スクリーン９上に拡大して表示させる。これにより、スクリーン９上には、前記液晶パネルに表示された映像画面が投射画面１０として形成されることになる。

【０００９】ところで、一般にこのような前面投射型液晶プロジェクタは、視聴者が本体１の背後からその投射画面を視聴することが多いため、視聴者の視界を本体１が遮らないように設置する場合もある。つまり、投射画面が本体１上方に位置するように投射する角度で本体１が設置されることになる。しかし、このような場合には、例えば図９に示すように液晶プロジェクタ本体１の設置状態に起因した投射角度のずれにより、一般に台形歪み（キーストン歪みとも呼ばれる）といわれる歪みのある投射画面１０を形成してしまうことになる。

【００１０】このような台形歪みを補正する手段としては、一般的に２つの方法があり、その一つは電気的に台形歪み補正する補正方法であり、もう一つは光学的に台形歪み補正する補正方法である。

【００１１】電気的に台形歪み補正する方法は、映像回路１１により液晶パネル５の表示面に投射画像とは逆の台形歪みのある映像画面を表示し、これを拡大投射することにより、投射画面の台形歪みを補正する方法である。

【００１２】もう一つの光学的に台形歪み補正する方法は、液晶プロジェクタ本体１内の、コンデンサレンズ６の傾きを調整することにより、投射画面の台形歪みを補正する方法である。

【００１３】あるいは、コンデンサレンズ６を傾けるのではなく、液晶パネル５自体を傾けるような構造を採用することで、台形歪みを補正することができる。

【００１４】しかしながら、上述した従来の電気的、光学的な台形歪み補正方法では、いずれもユーザの操作によってその補正を行うものであることから、確実に台形歪み補正するには、微妙なレベル調整等が必要であるため、その操作内容が煩雑であり、容易に行うことが出来ないという問題点があった。

【００１５】

【発明が解決しようとする課題】上記の如く、従来の台形歪み補正方法では、電気的、あるいは光学的に入力映像信号自体あるいは液晶パネルの透過光に投射画面とは逆の台形歪みを発生させて、投射画面に生じた台形歪みを軽減するように補正していたが、これらの方法では、いずれもユーザの操作によってその補正を行うものであることから、確実に台形歪み補正するには、微妙なレベル調整等が必要であるため、その操作内容が煩雑であり、容易に行うことが出来ないという問題点があった。

【００１６】そこで、本発明は上記の問題に鑑みてなされたもので、ユーザによる煩雑な補正操作を必要とせず、自動的に且つ確実に投射画面に生じた台形歪みを補正することのできる台形歪み補正装置の提供を目的とするものである。

【００１７】

【課題を解決するための手段】請求項１記載の発明による台形歪み補正装置は、入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、前記入力映像信号に基づく画像を前記液晶パネル面上に形成させるための処理を行う処理回路であって、入力映像信号に対応した画素データを記憶するメモリを備え、該メモリの画素データのライン毎の書き込み、読み出しのタイミングを変化させることにより、ライン毎の画素データの間引き調整が可能な映像処理回路と、前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記映像処理回路を自動制御する補正制御手段と、を具備したものである。

【００１８】この発明によれば、前記液晶表示装置本体前面の異なる位置に複数設けられた距離検出手段によって、該液晶表示装置本体と前記スクリーンとの距離がそれぞれ検出される。前記映像処理回路は、前記入力映像信号に基づく画像を前記液晶パネル面上に形成させるための処理を行う処理回路で、入力映像信号に対応した画素データを記憶するメモリを備え、該メモリの画素データのライン毎の書き込み、読み出しのタイミングを変化させることにより、ライン毎の画素データの間引き調整が可能である。台形歪み発生時、補正制御手段は、前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記映像処理回路を自動制御する。これにより、液晶パネルの投射画像光は前記投射画面の台形歪み形状とは逆の台形歪み形状有するものとなるため、結果として台形歪みを軽減することができ、しかも自動的にこの台形歪み補正を行

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うことが可能となる。

【００１９】請求項２に記載の発明の台形歪み補正装置は、入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、前記液晶パネルからの投射画像光を集光し、投射レンズを介してスクリーンへと照射するためのレンズであって、該レンズ自体の傾斜角を自在に変化させる駆動手段を備えたコンデンサレンズと、前記コンデンサレンズの前記駆動手段を制御可能な角度調整手段と、前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記角度調整手段を自動制御する補正制御手段と、を具備したものである。

【００２０】この発明によれば、前記補正制御手段によって、前記角度調整手段を制御してコンデンサレンズの傾斜角を変化させることで、前記投射画面の台形歪み形状とは逆の台形歪み形状を有する液晶パネルの投射画像光が得られる。これにより、上記発明と同様の効果が得られる。

【００２１】請求項３に記載の発明の台形歪み補正装置は、入力映像信号に基づき形成された液晶パネル面上の形成画像を、光源からの照射光により投射し、その投射画像光を光学系手段を介してスクリーン上に拡大表示する液晶表示装置において、前記液晶表示装置本体前面の異なる位置に複数設けられ、該液晶表示装置本体と前記スクリーンとの距離をそれぞれ検出し、検出結果を出力する距離検出手段と、前記液晶パネル自体の傾斜角を自在に変化させる駆動手段を備えた液晶パネルと、前記液晶パネルの前記駆動手段を制御可能な角度調整手段と、前記距離検出手段からの検出結果に基づき前記スクリーンに対する前記液晶表示装置本体の傾斜角を算出し、この算出結果に基づいて、前記液晶表示装置本体の傾斜角に起因する投射画面の台形歪みを補正するように前記角度調整手段を自動制御する補正制御手段と、を具備したものである。

【００２２】この発明によれば、前記補正制御手段によって、前記角度調整手段を制御して液晶パネルの傾斜角を変化させることで、前記投射画面の台形歪み形状とは逆の台形歪み形状を有する液晶パネルの投射画像光が得られる。これにより、上記発明と同様の効果が得られる。

【００２３】

【発明の実施の形態】発明の実施の形態について図面を参照して説明する。図１は本発明の台形歪み補正装置の

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一実施の形態を示し、該装置を組み込んで構成された前面投射型の液晶プロジェクタの構成例を示すブロック図である。

【００２４】本実施の形態では、前面投射型の液晶プロジェクタの設置状態に起因して生じる投射画面の台形歪みを自動的に補正するために、液晶プロジェクタ本体１の前面側上下にスクリーン９との距離をそれぞれ検出する距離検出手段としての第１及び第２の距離センサ３０，３１を設け、これらの第１及び第２の距離センサ３０，３１により得られた検出結果に基づいて、従来技術で用いた映像回路内の処理を行うことにより、その目的を達成するようにしている。

【００２５】具体的な全体構成としては、本実施の形態の台形歪み補正装置を組み込んだ前面投射型液晶プロジェクタは、図１に示すように、上記第１及び第２の距離センサ３０，３１、制御マイコン３２等を設けた点に特徴がある。

【００２６】つまり、図１に示すように、液晶プロジェクタには、表示する映像ソースの映像信号を入力するための入力端子１ａを備え、この入力端子１ａを介して供給された入力映像信号は、本体１内部に設けられた主要回路としての映像回路１１Ａに供給される。

【００２７】映像回路１１Ａは、通常、入力映像信号に基づく映像を正確に再現するために、入力映像信号に対し液晶パネル５を駆動するのに必要な電圧まで増幅させたり、液晶の長寿命化のための交流駆動を行う等の機能を有する液晶駆動回路や台形歪みを補正するのに必要な処理回路等が主となって構成されている。つまり、この映像回路１１Ａは、入力映像信号に基づく映像を該液晶プロジェクタに使用される液晶パネル５の表示面に表示するために必要な信号処理を入力映像信号に施すことにより、入力映像信号に応じたパネル駆動信号を得て液晶パネル５に与える。これにより、液晶パネル５の表示面には入力映像信号に基づく映像画面が表示される。また、映像処理回路１１Ａは、投射画面１０に台形歪みが発生している場合には、投射画面１０とは逆の台形歪みを発生するための処理を入力映像信号に施すことにより、投射画面１０の台形歪みを軽減せるためのパネル駆動信号を液晶パネル５に与えることで、液晶パネル５の表示面には投射画面１０に生じた台形歪みを補正するのに必要な処理が施された補正映像画面が表示される。

【００２８】一方、リフレクタ等を用いて光源３から照射された可視光４は、液晶パネル５の表示面を透過し、透過した液晶パネル５の透過光７は、コンデンサレンズ６によって絞り込まれ、投射レンズ２によって拡大投射されることによって、スクリーン９上に拡大して表示させる。これにより、スクリーン９上には、前記液晶パネルに表示された映像画面が投射画面１０として形成されることになる。

【００２９】ところが、従来技術で述べたように、視聴

者が本体１の背後からその投射画面を視聴することに起因して、視聴者の視界を本体１が遮らないように本体１を設置したりすると、その液晶プロジェクタ本体１の設置状態に起因した投射角度のずれにより、投射画面に台形歪みが発生してしまい、見づらい表示映像となる。

【００３０】そこで、本実施の形態においては、このような台形歪みを補正する手段として、映像回路１１Ａ（図７における映像回路１１と略同じ構成）を用いて、台形歪みの程度に応じて投射レンズ２の出射光に投射画面と逆の台形歪みを発生させ、投射画面の台形歪みを軽減するように補正する補正方法が採用されている。

【００３１】この映像回路１１Ａを用いた補正方法では、図１に示す映像回路１１Ａにより液晶パネル５の表示面に台形歪みのある映像画面を表示し、これを拡大投射することにより、投射画面の台形歪みを補正する方法である。すなわち、映像回路１１Ａによる処理を調整することにより、結果的に投射画面の台形歪みを補正する。

【００３２】具体的には、図３に示すように１ラインもしくは数ライン毎に水平走査開始と終了時に黒信号（無映像信号）を表示するようにし、垂直走査が進むに従い、台形歪みの角度に応じて一定の割合で黒信号部分を少なくして表示する。例えば前記液晶パネル５がＭ画素（水平）×Ｎ画素（垂直）の画素数で構成され、図の右下から左へ、また下から上へ走査するものとすると、垂直走査開始時の１ラインでは、水平走査開始時と終了時とにｑ画素のずつの黒信号部分を表示し、黒信号部分の間にはＭ画素のデータを２ｑ画素分間引いたＭ－２ｑ画素の映像データを表示する。垂直走査が数ライン進んだＬラインでは、ｑ画素より少ないｐ画素の無信号部を表示する。この場合のｐ画素は、ｐ＝ｑ（Ｎ－Ｌ）／Ｎ画素　という関係式で示すことができる。映像表示部分は、２ｐ画素分間引いたＭ－２ｐ画素の映像データを表示する。そして、図中に示すように垂直走査最終ラインのＮラインでは、黒信号部分を表示しない。これにより、液晶パネル５の表示面に台形歪みのある映画画面を表示させることで投射画面の台形歪みを補正することが可能である。

【００３３】このように液晶パネル５の表示動作を制御するのに必要な映像回路１１Ａの具体構成が図４に示されており、また図１の該映像回路１１Ａの制御動作を説明するためのタイミングチャートが図５に示されており、以下、具体的な動作を説明する。

【００３４】映像回路１１Ａにおいて、図４に示すように入力端子１１ａを介して入力された映像信号は、Ａ／Ｄ変換器１１ｂに供給され、該Ａ／Ｄ変換器１１ｂにより、制御信号発生回路１１ｄからのサンプルクロック（図５（ａ）参照）によりサンプリング処理が施されることで、Ｍ×Ｎ画素で構成されるディジタル化した映像データ（画素データともいう）に変換される。その後、この映像データは前記サンプリングクロックと同じタイミングの書き込み制御信号に基づくタイミングでメモリ１１ｃに書き込まれるようになっている（図５（ｂ），（ｄ），（ｆ）参照）。

【００３５】次のフィールドでは、各々のラインに書き込まれた画素データは、制御信号発生回路１１ｄからの読み出し制御信号に基づき前記書き込み制御信号とは異なるタイミングで読み出され、Ｄ／Ａ変換器１１ｅに供給される。すなわち、制御信号発生回路１１ｄは、メモリへの映像データの書き込み制御及び読み出し制御が可能であり、これらのタイミングを変化させることにより、各ラインの映像データを自在に間引くことが可能である。

【００３６】Ｄ／Ａ変換器１１ｅは、制御信号発生回路１１ｄからのサンプルクロックのタイミングで再度アナログ信号に変換して戻し、戻した映像信号を液晶駆動回路１１ｆに与える。液晶駆動回路１１ｆでは、入力映像信号に対し液晶パネル５を駆動するのに必要な電圧まで増幅させ、その後交流駆動を行うための極性反転処理等の処理を施すことにより、映像信号に応じたパネル駆動信号が生成され、液晶パネル５に供給されることで、液晶パネル５の表示面には入力映像信号に基づく映像が表示される。

【００３７】このとき、制御信号発生回路１１ｄは、１ラインでは走査開始からサンプルクロック１～ｑ個（画素）分は読み出さず、黒信号を表示するように制御する。そして、ｑ＋１個目に最初の画素データ１を読み出し、Ｍ－ｑ個目で最後の画素データＭを読み出すまでの２ｑ個間引いたＭ－２ｑ画素分のデータを読み出す。それ以降は、再度ｑ画素分を読み出さず、黒信号を表示するように制御する（図５（ｃ）参照）。

【００３８】垂直走査が進んだＬラインでは、同様に走査開始からサンプルクロック１～ｐ個（画素）分は読み出さず、黒信号を表示するように制御する（図５（ｃ）参照）。そして、ｐ＋１個目に最初の画素データを読み出し、サンプルクロックＭ－ｐ個目で最後の画素データＭを読み出すまでの２ｐ画素を間引いたＭ－２ｐ画素分のデータを読み出すように制御する。それ以後のタイミングでは、制御信号発生回路１１ｄは、再度ｐ画素分を読み出さず、黒信号を表示するように制御する（図５（ｅ）参照）。

【００３９】垂直走査最後のＮラインでは、無信号部分を表示せず、書き込んだデータＭ個をそのまま読み出し、液晶パネル５に供給することで、その読み出した映像データに基づく画像を液晶パネル５の表示面に表示させる。

【００４０】以上、述べた制御動作により、投射画面に生じた台形歪みを補正するのに必要な、逆の台形歪みを液晶パネルの表示面上に発生させるようにしている。

【００４１】ところが、上述した映像回路１１Ａのみの

補正処理では、自動補正することができない。

【００４２】そこで、本実施の形態では、上記映像回路１１Ａによる台形歪み補正処理を自動的に行うために必要な第１及び第２の距離センサ３０，３１と、これらの第２の距離センサ３０，３１により得られた検出結果に基づきスクリーン９の投射画面１０の傾斜角度を算出し、算出結果に基づき投射画面１０の台形歪みとは逆の台形歪みを有する液晶パネルの表示画像を精度良く形成するために前記の映像回路１１Ａによる処理を制御する制御マイコン３２とが設けられている。

【００４３】この制御マイコン３２の制御による台形歪み補正の動作を図２をも参照して説明する。

【００４４】前記第第１及び第２の距離センサ３０，３１は、該プロジェクタ本体１の前面側、つまり、投射レンズ２側の上下方向にそれぞれ配置して設けられている。これらの第１及び第２の距離センサ３０，３１は、例えばそれぞれ光りを出射し、その光の反射光を受光することによって、本体１の前面部とスクリーン９との距離Ｄ１，Ｄ２を測定し、測定結果を電気信号として制御マイコン３２にそれぞれ与える。なお、第１及び第２の距離センサ３０，３１としては、光を利用したものでなくともそれぞれの距離が得られるようなものであれば、他のセンサを用いて構成しても良い。

【００４５】制御マイコン３２は、例えば液晶プロジェクタのシステム全般を制御する制御マイコンであって、前記第１及び第２の距離センサ３０，３１からの測定結果が供給された場合には、投射画面１０に生じた台形歪みを補正すべく、供給された測定結果に基づき前記映像回路１１Ａによる処理を調整制御する。

【００４６】例えば、制御マイコン３２は、前記第１及び第２の距離センサ３０，３１からの測定結果から本体１とスクリーン９との傾斜角度θを算出し、この算出結果を基にその台形歪みの形状を演算処理した後に、この演算処理結果に基づき、投射画面１０の台形歪みとは逆の台形歪みとなるパネル駆動信号が得られるように前記の映像回路１１Ａによる処理を制御する。このときの制御マイコン３２による傾斜角度の算出は、例えば図２に示すように、本体１とスクリーン９との傾斜角度をθとし、正常な投射画面１０の縦幅をｄ（各センサ３０，３１の光をセンサ平行光した場合、各センサ平行光Ｄ１，Ｄ２間の距離に相当）とすると、

$$\tan\theta = d/(D1-D2) \quad \cdots (式1)$$

で、求めることが可能である。

【００４７】また、制御マイコン３２による映像処理回路１１Ａへの制御は、演算処理結果に基づく逆の台形歪みを発生するための制御信号を、映像回路１１Ａ内の制御信号発生回路１１ｄ（図４参照）に与えることにより、該制御信号発生回路１１ｄはこれに応答して、各ラインの読み出し制御信号のタイミングを変化させるように制御する。これにより、図３乃至図５にて説明したようなメモリ１１ｃ（図４参照）を用いた各ライン毎の画素データを調整することで、投射画面１０に生じている台形歪み形状とは逆の台形歪みを有するパネル表示画面を得ることが可能となり、結果として本体１とスクリーン９との傾斜角度に起因して生じる投射画面１０の台形歪みを、その発生形状に応じて自動的に且つ確実に補正することが可能となる。

【００４８】したがって、本実施の形態では、ユーザの煩雑な操作を行わずとも、自動的に且つ確実に投射画面に生じた台形歪みを補正することが可能となり、台形歪みを抑えた品位の高い液晶投射映像が得られる高性能な前面投射型液晶プロジェクタの提供を実現できる。

【００４９】次に、本発明の台形歪み補正装置の他の実施の形態について図６を用いて詳細に説明する。

【００５０】図６は本発明の他の実施の形態の台形歪み補正装置を組み込んだ液晶プロジェクタの構成例を示すブロック図である。

【００５１】本実施の形態では、前記実施の形態における電気的な台形歪み補正方法ではなく、光学的に台形歪みを補正する補正方法に適用させることにより、自動的に台形歪み補正を行うように構成したことが前記実施の形態と異なる点である。

【００５２】具体的な構成としては、本発明の特徴である第１及び第２の距離センサ３０，３１と、これらの第２の距離センサ３０，３１により得られた検出結果に基づきスクリーン９の投射画面１０の傾斜角度を算出し、算出結果に基づき、液晶パネルの透過光が投射画面１０の台形歪みとは逆の台形歪みとなるようにコンデンサレンズ６の傾斜角度を制御する制御マイコン３２Ａとがそれぞれ組み込まれて構成されている。

【００５３】図６に示す主要回路となる角度調整装置２０は、コンデンサレンズ６に備えられた駆動手段（図示せず）を制御することにより、そのコンデンサレンズ６自体の傾きを調整するものである。すなわち、コンデンサレンズ６の傾きを、例えば図中に示す波線２１のように傾けることで、液晶パネル５の透過光に投射画面とは逆の台形歪みを生じさせるようにして、結果的に投射画面の台形歪みを補正する。

【００５４】本実施の形態では、上記光学的な台形歪み補正を自動的に行うために、第１及び第２の距離センサ３０，３１は、前記実施の形態と同様にそれぞれ光りを出射し、その光の反射光を受光することによって、本体１の前面部とスクリーン９との距離Ｄ１，Ｄ２を測定し、測定結果を電気信号として制御マイコン３２Ａにそれぞれ与える。

【００５５】制御マイコン３２Ａは、前記第１及び第２の距離センサ３０，３１からの測定結果から本体１とスクリーン９との傾斜角度を算出し、この算出結果を基にその台形歪みの形状を演算処理した後に、この演算処理結果に基づき、液晶パネルの可視光が投射画面１０の台

形歪みとは逆の台形歪みとなるような制御信号を角度調整装置２０に与えることにより、これに応答して角度調整装置２０はコンデンサレンズ６の傾きを例えば波線２１に示すように最適な角度に調整制御する。

【００５６】これにより、コンデンサレンズ６の傾きがその台形歪みの形状に応じて調整されるため、液晶パネルの透過光は投射画面１０に生じている台形歪み形状とは逆の台形歪みを有するものとなり、結果として本体１とスクリーン９との傾斜角度θに起因して生じる投射画面１０の台形歪みを、その発生形状に応じて自動的に且つ確実に補正することができる。

【００５７】また、本発明では、他の光学的な台形歪みの補正方法に適用する事も可能である。このような実施の形態を図７を参照しながら詳細に説明する。

【００５８】図７は本発明の他の実施の形態の台形歪み補正装置を組み込んだ液晶プロジェクタの構成例を示すブロック図である。

【００５９】本実施の形態では、前記実施の形態にて説明した光学的な台形歪み補正方法とほぼ同様であるが、コンデンサレンズの傾斜を最適な角度に制御するものではなく、液晶パネル５自体を台形歪みを補正するの必要な最適な角度に調整制御することにより、自動的に台形歪み補正を行うように構成したことが前記実施の形態と異なる点である。

【００６０】具体的な構成としては、本発明の特徴である第１及び第２の距離センサ３０，３１と、これらの第２の距離センサ３０，３１により得られた検出結果に基づきスクリーン９の投射画面１０の傾斜角度を算出し、算出結果に基づき、液晶パネルの透過光が投射画面１０の台形歪みとは逆の台形歪みとなるように液晶パネル５の傾斜角度を制御する制御マイコン３２Ｂとがそれぞれ組み込まれて構成されている。

【００６１】図７に示す主要回路となる角度調整装置２２は、液晶パネル５に備えられた駆動手段（図示せず）を制御することにより、その液晶パネル５自体の傾きが調整される。すなわち、液晶パネル５の傾きを、例えば図中に示す波線２３のように傾けることで、液晶パネル５の透過光に投射画面とは逆の台形歪みを生じさせるようにして、結果的に投射画面の台形歪みを補正する。

【００６２】本実施の形態では、上記光学的な台形歪み補正を自動的に行うため、第１及び第２の距離センサ３０，３１は、前記実施の形態と同様にそれぞれ光りを出射し、その光の反射光を受光することによって、本体１の前面部とスクリーン９との距離Ｄ１，Ｄ２を測定し、測定結果を電気信号として制御マイコン３２Ｂにそれぞれ与える。

【００６３】制御マイコン３２Ｂは、前記第１及び第２の距離センサ３０，３１からの測定結果から本体１とスクリーン９との傾斜角度を算出し、この算出結果を基にその台形歪みの形状を演算処理した後に、この演算処理

結果に基づき、液晶パネルの可視光が投射画面１０の台形歪みとは逆の台形歪みとなるように制御信号を角度調整装置２２に与えることにより、これに応答して角度調整装置２２は、液晶パネル５の傾きを例えば波線２３に示すように最適な角度に調整制御する。

【００６４】これにより、液晶パネル５の傾きがその台形歪みの形状に応じて調整されるため、液晶パネルの透過光は投射画面１０に生じている台形歪み形状とは逆の台形歪みを有するものとなり、結果として本体１とスクリーン９との傾斜角度θに起因して生じる投射画面１０の台形歪みを、その発生形状に応じて自動的に且つ確実に補正することができる。

【００６５】したがって、本実施の形態によれば、前記実施の形態と同様の効果が得られる。

【００６６】なお、本発明に係る各実施の形態においては、制御マイコン３２，３２Ａ，３２Ｂによって、第１及び第２の距離センサ３０，３１からの算出結果に基づいて投射画面に生じた台形歪み形状とは逆の台形歪み形状が得られるように演算処理を行い、この演算処理結果に基づき映像回路または角度調整装置２０，２２を制御することにより、台形歪み補正処理を行うように説明したが、例えばそれぞれの制御マイコン内に予め本体に対するスクリーンの傾斜角度に応じた台形歪みの形状データを記憶したテーブルメモリ等を設け、台形歪み補正する場合には、前記該テーブルメモリを参照して前記第１及び第２の距離センサ３０，３１からの算出結果に対応する台形歪み形状データを得、この得られた台形歪み形状に基づき映像回路または角度調整装置等を制御して、台形歪み補正を行うように構成しても良い。

【００６７】

【発明の効果】以上、述べたように本発明によれば、ユーザによる煩雑な補正操作を必要とせず、自動的に且つ確実に投射画面に生じた台形歪みを補正することが可能となり、その結果、台形歪みを抑えた品位の高い液晶投射映像が得られる高性能な前面投射型液晶プロジェクタの提供を実現できる。

【図面の簡単な説明】

【図１】本発明の台形歪み補正装置の一実施の形態を示し、該装置が組み込まれた液晶プロジェクタの全体構成を示すブロック図。

【図２】図１の制御マイコンによる本体とスクリーンとの角度算出方法を説明するための説明図。

【図３】台形歪みを電気的に補正する補正方法を説明するための説明図。

【図４】電気的台形歪み補正を実施するための映像回路の構成例を示すブロック図。

【図５】図４に示す映像回路によるメモリへの映像データの書き込み、読み出し制御を説明するためのタイミングチャート。

【図６】本発明の他の実施の形態の台形歪み補正装置を

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示し、該装置を光学的な補正方法に適用した場合の液晶プロジェクタの構成を示すブロック図。

【図７】本発明の他の実施の形態の台形歪み補正装置を示し、該装置を光学的な補正方法に適用した場合の液晶プロジェクタの構成を示すブロック図。

【図８】一般的な前面投射型液晶プロジェクタの構成を示すブロック図。

【図９】台形歪みの発生状態を説明するための説明図。

【符号の説明】

１…液晶プロジェクタ本体、

２…投射レンズ、

３…光源、

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４…可視光、

５…液晶パネル、

６…コンデンサレンズ、

７…パネル透過光、

８…光軸、

９…スクリーン、

１０…投射画面、

１１Ａ…映像回路、

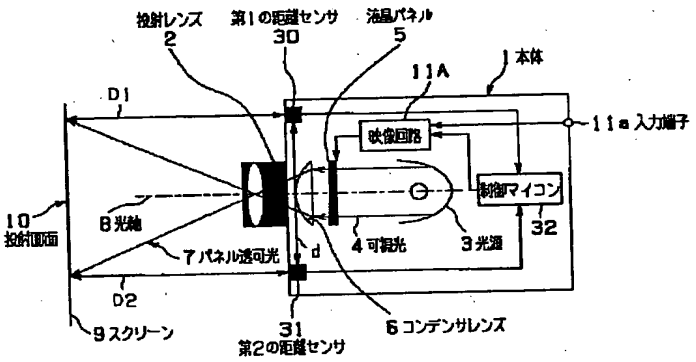
２０，２２…角度調整装置、

１０　３０…第１の距離センサ（距離検出手段）、

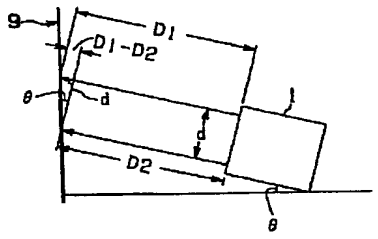
３１…第２の距離センサ（距離検出手段）、

３２，３２Ａ，３２Ｂ…制御マイコン（制御手段）。

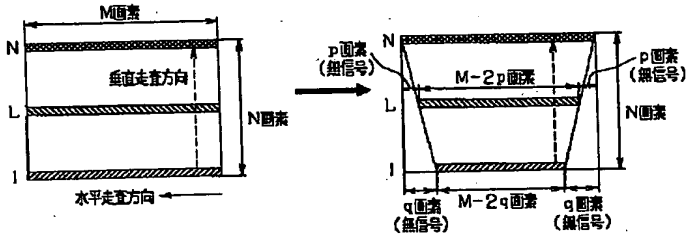
【図１】



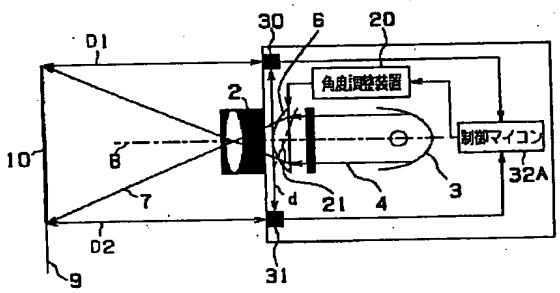
【図２】



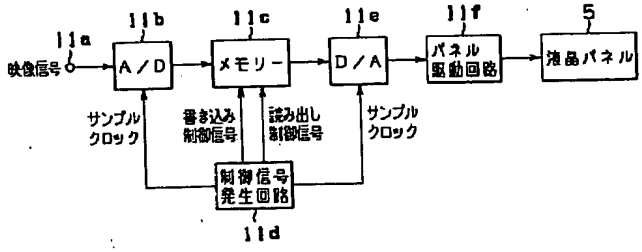
【図３】



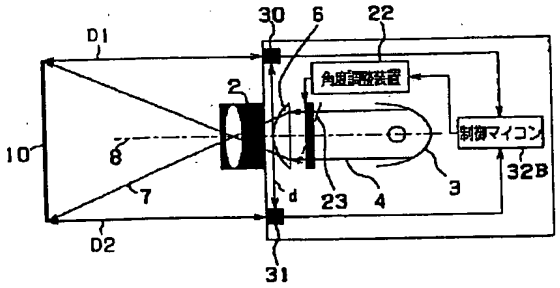
【図６】



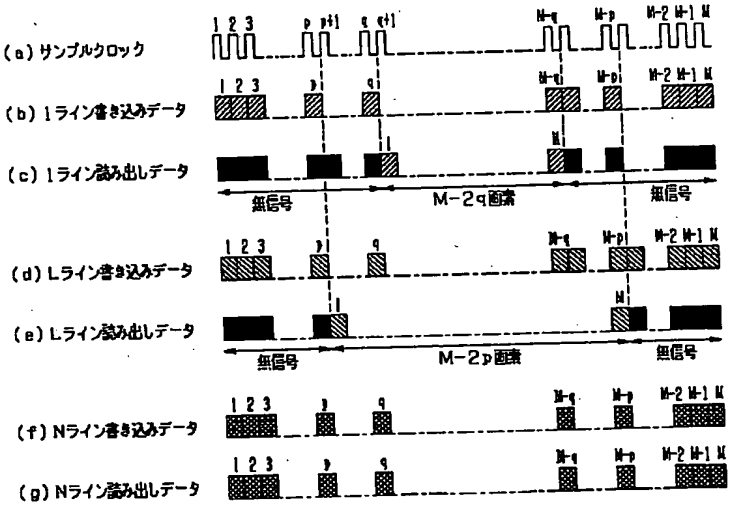
【図４】



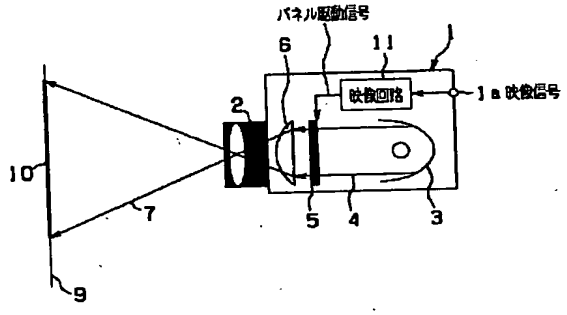
【図７】



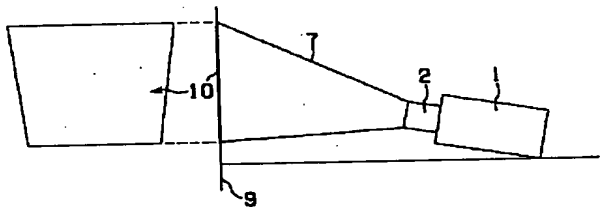
【図５】



【図８】



【図９】



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